

1. A high efficiency switching amplifier for digitally processing electric power from a DC supply thereof to a loudspeaker, the switching amplifier comprising:

- a voltage source for supplying a DC voltage,
- a power modulator for transforming the DC voltage into modulated voltages,
- a transformer for changing the amplitudes of the modulated voltages,
- a synchronous demodulator for reconstructing the modulated voltages back to audio signal driving a loudspeaker,
- a controller for receiving an audio signal to produce digital signals controlling the operation of the power modulator and the synchronous demodulator,

wherein the controller controlling the timing of digital signals to the power modulator and to the synchronous demodulator such that they change state substantially synchronously.

2. A high efficiency switching amplifier comprising:

- a transformer having a primary winding with a first terminal, a second terminal, a third terminal which is a primary center tap, and a secondary winding with a fourth terminal, a fifth terminal, and a sixth terminal which is a secondary center tap,
- a power modulator comprising a first switch for selectively connecting the first terminal of the transformer to a primary ground reference, and a second switch for selectively connecting the second terminal of the transformer to the primary ground reference,
- a voltage source connected between the third terminal and the primary ground reference,
- a synchronous demodulator comprising a third and fourth switches for selectively connecting the fourth and fifth terminals of the transformer to a secondary ground reference, four switches in a H-bridge configuration for selectively connecting the sixth terminal of the transformer to the secondary ground reference through a load,
- a controller for receiving an audio signal to produce digital signals controlling the operation of the power modulator and the synchronous demodulator,

wherein the four switches of the H-bridge provide a bipolar signal to the load connected across the H-bridge, and wherein the controller controlling the timing of the power modulator to operate it in zero current switching.

3. A high efficiency switching amplifier comprising:

- a transformer having a primary winding and a secondary winding having a first terminal, a second terminal, a third terminal which is a center tap,
- a voltage source connected to the primary winding of the transformer,
- a power modulator for selectively connecting the primary winding of the transformer to a primary ground reference,
- a synchronous demodulator comprising a first and second switches for selectively connecting the first and second terminals of the transformer to a secondary ground

- reference, and four switches in a H-bridge configuration for selectively connecting the center tap of the transformer to the secondary ground reference via a load,
- a controller for receiving an audio signal to produce digital signals controlling the operation of the power modulator and the synchronous demodulator,
- wherein the four switches of the H-bridge provide a bipolar signal to the load connected across the H-bridge, and wherein the controller controlling the timing of the power modulator and the first and second switches of the synchronous demodulator to operate them in zero current switching.
4. The switching amplifier of claim 3 wherein the power modulator is a push-pull power switch.
  5. The switching amplifier of claim 3 wherein the power modulator is a half-bridge power switch.
  6. The switching amplifier of claim 3 wherein the power modulator is a full-bridge power switch.
  7. A high efficiency switching amplifier comprising:
    - a transformer having a multiple-tap winding with a first terminal, a second terminal, a third terminal which is a center tap, a fourth terminal, and a fifth terminal,
    - a power modulator comprising a first and second switches for selectively connecting the first and second terminals of the transformer to a ground reference,
    - a voltage source connected between the third terminal of the transformer and the ground reference,
    - a synchronous demodulator comprising a first and a second bi-directional switches having a common connection node and each connected in series with the fourth and fifth terminals of the transformer, and four switches in a H-bridge configuration for selectively connecting the common connection node of the first and second bi-directional switches to the ground reference through a load,
    - a controller for receiving an audio signal to produce digital signals controlling the operation of the power modulator and the synchronous demodulator,wherein the controller controlling the timing of the power modulator to operate it in zero current switching.
  8. The switching amplifier of claim 7 wherein the synchronous demodulator comprises four bi-directional switches in a H-bridge configuration for selectively connecting the fourth and fifth terminals of the transformer to ground reference through a load.
  9. The switching amplifier of claim 7 wherein the power modulator comprises additionally a third switch in series with the center tap of the transformer and wherein the four switches of the H-bridge are MOSFETs.
  10. The switching amplifier of claim 8 wherein the transformer is an isolating transformer having a primary winding and a secondary winding, the secondary winding having a center tap.

11. The switching amplifier of claim 10 wherein the synchronous demodulator comprises four MOSFETs in a H-bridge configuration and a fifth MOSFET connected in series with the center tap.
12. The switching amplifier of claim 11 wherein the power modulator is a half-bridge power modulator.
13. The switching amplifier of claim 11 wherein the power modulator is a full-bridge power modulator.
14. The switching amplifier of claim 10 wherein the isolating transformer is split into two isolating transformers having windings connected in series.
15. The switching amplifier of claim 14 wherein two of the four switches in a H-bridge configuration are relocated to be connected to the ground reference.
16. The switching amplifier of claim 15 wherein the four switches are ground-referenced MOSFETs.
17. A high efficiency switching amplifier for digitally processing electric power from a DC supply to drive a loudspeaker isolated from the DC supply, the switching amplifier comprising:
  - a voltage source for supplying a DC voltage,
  - a power modulator for transforming the DC voltage into modulated voltages,
  - two transformers for changing the amplitudes of the modulated voltages, the two transformers having each a primary winding and a secondary winding, the two primary windings being connected in series,
  - a synchronous demodulator for reconstructing the modulated voltages back to audio signal driving a loudspeaker, the demodulator comprising four bi-directional switches selectively connecting the two secondary windings to a secondary ground reference isolated from the voltage source, through the loudspeaker,
  - a controller for receiving an audio signal to produce digital signals controlling the operation of the power modulator and the synchronous demodulator,wherein the controller controlling the timing of digital signals to the power modulator and to the synchronous demodulator such that they change state substantially synchronously.
18. The switching amplifier of claim 17 wherein the four bi-directional switches of the synchronous demodulator are transistors.
19. The switching amplifier of claim 17 wherein the four bi-directional switches of the synchronous demodulator are four MOSFETs.
20. A method for reducing switching losses of a switching amplifier having a power modulator, a transformer, a synchronous demodulator, and a controller, the method comprising adaptively sending timing signals to the power modulator, and after predetermined delays, sending timing signals to the synchronous demodulator, wherein the predetermined delays cause the power modulator to operate in zero current switching.